# LIDA-SRS-KIT

# Lock-In Digital Amplifier Radiometry System

User's Manual

ORIEL INSTRUMENTS
A Newport Corporation Brand

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# 1 GENERAL INFORMATION

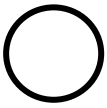
Thank you for your purchase of this Lock-In Digital Amplifier System from Oriel Instruments.

Please carefully read the following important safety precautions prior to unpacking and operating this equipment. In addition, please refer to the complete User's Manual and all other documentation provided for additional important notes and cautionary statements regarding the use and operation of the system.

Do not attempt to operate the system without reading all the information provided with each of the components.

## 1.1 SYMBOLS AND DEFINITIONS

| | |
|---|---|
| | **WARNING**<br>Situation has the potential to cause bodily harm or death. |
| | **CAUTION**<br>Situation has the potential to cause damage to property or equipment. |
| | **ELECTRICAL SHOCK**<br>Hazard arising from dangerous voltage. Any mishandling could result in irreparable damage to the equipment, and personal injury or death. |
| | **HOT SURFACE**<br>Hazard arising from hot surfaces. Objects or persons making contact with a hot surface could result in personal injury or damage to property or equipment. |
| | **EUROPEAN UNION CE MARK**<br>The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations. |
| Note: | Additional important information the user or operator should consider. |

| | |
|---|---|
| | **WARNING**<br>Situation has the potential to cause bodily harm or death. |
| | **ALTERNATING (AC) VOLTAGE**<br>This international symbol designates an alternating voltage. |
| | **WEEE**<br>This symbol on the product or on its packaging indicates that this product must not be disposed of with regular waste. Instead, it is the user's responsibility to dispose of waste equipment according to the local laws. The separate collection and recycling of the waste equipment at the time of disposal will help to conserve natural resources and ensure that the materials are recycled in a manner that protects human health and the environment. |
| | **PROTECTIVE CONDUCTOR TERMINAL**<br>The protective conductor terminal symbol in the above figure identifies the location of the bonding terminal inside the unit, which is bonded to conductive accessible parts of the enclosure for safety purposes. |
|  | **ON**<br>The ON symbol in the above figure indicates the ON position of the power switch. |
|  | **OFF**<br>The OFF symbol in the above figure indicates the OFF position of the power switch. |

**Please read <u>all</u> instructions that were provided prior to operation of the system. If there are any questions, please contact Oriel Instruments or the representative through whom the system was purchased.**

## 1.2 GENERAL WARNINGS

- Read all warnings and operating instructions for this system prior to setup and use.
- Do not use this equipment in or near water.
- To prevent damage to the equipment, read the instructions in the equipment manual for proper input voltage.
- This equipment is grounded through the grounding conductor of the power cords.
- Route power cords and other cables so they are not likely to be damaged.
- Disconnect power before cleaning the equipment
- Do not use liquid or aerosol cleaners; use only a damp lint-free cloth.
- Lock out all electrical power sources before servicing the equipment.
- To avoid explosion, do not operate this equipment in an explosive atmosphere.
- Qualified service personnel should perform safety checks after any service.
- If this equipment is used in a manner not specified in this manual, the protection provided by this equipment may be impaired.
- To prevent damage to equipment when replacing fuses, locate and correct the problem that caused the fuse to blow before re-applying power.
- Do not block ventilation openings.
- Do not position this product in such a manner that would make it difficult to disconnect the power cords.
- Use only the specified replacement parts.
- Follow precautions for static sensitive devices when handling this equipment.
- This product should only be powered as described in the manual.
- Do not remove the cover for normal usage

## 1.3 ELECTRICAL HAZARDS

Make all connections to or from the power supply with the power off.

Do not use the lock-in digital amplifier without its cover in place. Lethal voltages are present inside.

## 1.4 FIRE HAZARDS

To avoid fire hazard, use only the specified fuses with the correct type number, voltage and current ratings as referenced in the appropriate locations in the service instructions or on the equipment. Only qualified service personnel should replace fuses.

# 2 INTRODUCTION

The LIDA-SRS-KIT is an easily integrated kit, which provides a powerful measurement metrology for experiments by removing background signals through phase sensitive detection. This technique is often used to extract very small signals obscured by noise sources many times larger by locking into the specific modulation frequency of your desired signal.

Oriel created an application kit (LIDA-SRS-KIT) using the Stanford Research Systems (SRS) Lock In Digital Amplifier (LIDA) model SR810. The LIDA-SRS-KIT includes the chopper, chopper control, and lock-in amplifier and readout (gauge or software) used in a typical experimental set-up and connects to any BNC-ended detector. A typical setup is shown in Figure 1.

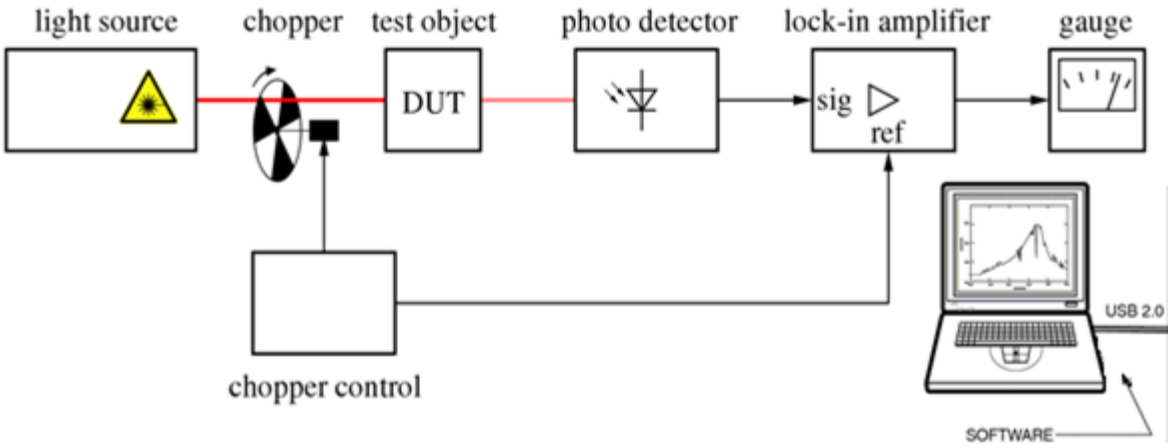



**Figure 1: Typical experimental setup**

In Figure 2, the Oriel model 75160NF chopper controller sits on top of a Stanford Research Systems (SRS) model SR810 Lock-In Digital Amplifier (LIDA) instrument. The chopper is being driven at 30Hz through the internal frequency generator of the SR810.

**Figure 2: The LIDA-SRS-KIT**

# 3 FEATURES

The LIDA-SRS-KIT includes the chopper, chopper control, lock-in amplifier, and readout (gauge or software) used in a typical experimental set-up and connects to any BNC-ended detector.

The Stanford Research Systems (SRS) SR810 Lock-In-Digital-Amplifier (LIDA) provides high performance at a reasonable cost and integrates into Oriel's product line.

- Single Channel
- Higher resolution frequency control
- Voltage or current input
- Wider range of time constant
- Internal or external reference frequency source
- Auto-gain, -phase, -reserve, and –offset
- Standard RS-232 and GPIB (IEEE488.2) interfaces
- "AUX IN" provides inputs for reference channels
- Reference input corrects your measurement channel to compensate for source drift
- "TTL OUT" controls the external chopper
- "PREAMP" connection may be used to power up detector pre-amplifiers

## 3.1 SR810 LOCK-IN DIGITAL AMPLIFIER (LIDA)

The SR810 Lock-in Digital Amplifier (LIDA) provides high performance at a reasonable cost. Simultaneously displays the magnitude and uses digital signal processing (DSP) to replace the demodulators, output filters, and amplifiers found in conventional lock-ins. The SR810 provides uncompromised performance with an operating range of 1 MHz to 102 kHz and 100 dB of drift-free dynamic reserve.

- Lock-In Digital Amplifier model SR810
- Oriel model 75160NF Optical Chopper System
- Cable, BNC male to male (2 meters long)
- Oriel TracQ Basic software
- Cable, BNC male to male (2 meters long)
- Cable, GPIB to USB
- U.S. and European power cords
- An electronic copy of this user's manual on a thumb drive

### 3.1.1 Input Channel

The SR810 Lock-In Amplifiers have differential inputs with 6 nV/√Hz input noise. The input impedance is 10 MΩ, and minimum full-scale input voltage sensitivity is 2 nV. The input can also be configured for current measurements with selectable current gains of 106 and 108 V/A. A line filter (50 Hz or 60 Hz) and a 2× line filter (100 Hz or 120 Hz) are provided to eliminate line related interference. However, unlike conventional lock-in amplifiers, no tracking band-pass filter is needed at the input. This filter is used by conventional lock-ins to increase dynamic reserve. Unfortunately, band pass filters also introduce noise, amplitude and phase error, as well as drift. The DSP based design of these lock-ins has such inherently large dynamic reserve that no tracking band-pass filter is necessary.

### 3.1.2 Extended Dynamic Reserve

The dynamic reserve of a lock-in amplifier at a given full-scale input voltage is the ratio (in dB) of the largest interfering signal to the full-scale input voltage. The largest interfering signal is defined as the amplitude of the largest signal at any frequency that can be applied to the input before the lock-in cannot measure a signal with its specified accuracy.

Conventional lock-in amplifiers use an analog demodulator to mix an input signal with a reference signal. Dynamic reserve is limited to about 60 dB and these instruments suffer from poor stability, output drift, and excessive gain and phase error. Demodulation in the SR810 Lock-In Amplifier is accomplished by sampling the input signal with a high-precision A/D converter, and multiplying the digitized input by a synthesized reference signal. This digital demodulation technique results in more than 100 dB of true dynamic reserve (no prefiltering). It is free of the errors associated with analog instruments.

### 3.1.3 Digital Filtering

The digital signal processor also handles the task of output filtering, allowing time constants from 10 µsec to 30,000 s, with a choice of 6, 12, 18 and 24 dB/oct roll-off. For low frequency measurements (below 200 Hz), synchronous filters can be engaged to notch out multiples of the reference frequency. Since the harmonics of the reference have been eliminated, (notably 2F), effective output filtering can be achieved with much shorter time constants.

### 3.1.4 Digital Phase Shifting

Analog phase shifting circuits have also been replaced with a DSP calculation. Phase is measured with 0.01° resolution, and the X and Y outputs are orthogonal to 0.001°.

### 3.1.5 Frequency Synthesizer

The built-in direct digital synthesis (DDS) source generates a very low distortion (-80 dBc) reference signal. Single frequency sine waves can be generated from 1 MHz to 102 kHz with 4½ digits of resolution. Both frequency and amplitude can be set from the front panel or from a computer. When using an external reference, the synthesized source is phase locked to the reference signal.

### 3.1.6 Auto Functions

Auto-functions allow parameters that are frequently adjusted allowing automatic setting by the instrument. Gain, phase, offset and dynamic reserve are each quickly optimized with a single key press. The offset and expand features are useful when examining small fluctuations in a measurement. The input signal is quickly nulled with the auto-offset function, and resolution is increased by expanding around the relative value by up to 100×. Harmonic detection is no longer limited to only the 2F component. Any harmonic (2F, 3F, ... nF) up to 102 kHz can now be measured without changing the reference frequency.

### 3.1.7 Analog Inputs and Outputs

The SR810 has user-defined output for measuring X, R, X-noise, Aux1, Aux 2, or the ratio of the input signal to an external voltage. The SR810 has X and Y analog outputs (rear panel) that are updated at 256 kHz. Four auxiliary inputs (16-bit ADCs) are provided for general purpose use, such as normalizing the input to source intensity fluctuations. Four programmable outputs (16-bit DACs) provide voltages from -10.5 V to +10.5 V and can be set via the front panel or computer interfaces.

### 3.1.8 Internal Memory

The SR810 Lock-In has an 8,000 point memory buffer for recording the time history of a measurement at rates up to 512 samples/s. Data transfers from the buffers using the computer interfaces. A trigger input provides externally synchronized data recording.

### 3.1.9 Easy Operation

The SR810 Lock-In Amplifier is simple to use. All instrument functions are set from the front-panel keypad, and a spin knob is provided to quickly adjust parameters. Up to nine different instrument configurations can be stored in non-volatile RAM for fast and easy instrument set-up. Standard RS-232 and GPIB (IEEE-488.2) interfaces allow communication with computers. All functions can be controlled and read through these interfaces.

# 4 BASIC SYSTEM SETUP

## 4.1 WHAT'S INCLUDED

The LIDA-SRS-KIT includes the following items:

- Lock-In Digital Amplifier model SR810
- Oriel model 75160NF Optical Chopper System
- Cable, BNC male to male (2 meters long)
- Oriel TracQ Basic software
- Cable, BNC male to male (2 meters long)
- Cable, GPIB to USB
- U.S. and European power cords
- An electronic copy of this user's manual on a thumb drive

Please refer to the Optical Chopper System user's manual for the items provided with the 75160NF.

## 4.2 REQUIRED ITEMS

The following items are required to be provided by the user for setting up the LIDA:

- Computer for TracQ Basic software installation
- Optical detector
- Detector signal cable with BNC male connector

Refer to the TracQ Basic user's manual for minimum system requirements for the computer. If an Oriel LIDA-compatible detector is utilized, it includes a signal cable and amplifier power cable.

## 4.3 UNPACKING

Remove all items from the shipping containers and verify each item is accounted for. The system is carefully packaged to minimize the possibility of damage during shipment. Inspect the shipping boxes for external signs of damage or mishandling. Inspect the contents for damage.

If any item is missing or damaged, immediately contact Oriel Instruments or the Newport representative from whom the system was purchased.

**WARNING**

Do not attempt to operate this equipment if there is evidence of shipping damage or there is suspicion that the equipment will not operate correctly. Damaged equipment may present hazards.

## 4.4 CHOOSING A LOCATION

Choose an installation location where the power requirements can be met for the system. Be sure power is not applied to the system until the setup has been completed.

The environment should be that of a typical laboratory atmosphere, without excessive humidity and contaminants in the air. Do not allow the ventilation holes on the system's components or its computer to be blocked. Air should be able to circulate freely around the system.

## 4.5 CHOPPER CONTROLLER CONNECTIONS

A lock-in digital amplifier is capable of reading read chopped light signals from an optical detector. Therefore, it is required to install the 75160NF Optical Chopper System. Install a wheel into the chopper head based on the desired chopping frequency and beam size. When using a wheel with more than two apertures, install the appropriate aperture disk supplied with the chopper head. Use the cable supplied with the 75160NF to connect the chopper controller to the enclosed chopper head. Refer to its user's manual for more details.

Connect one end of the BNC cable supplied with the LIDA to "TTL OUT" on the back of the SR810. Connect the other end to "REF" on the front of the chopper controller. This allows TracQ Basic software to control the chopping frequency through the LIDA. For signal reading accuracy, the frequency must be synchronized between the LIDA and the chopper.

**Figure 3: Chopper Synchronization Connections**

## 4.6 COMPUTER CONNECTIONS

Install the driver provided with the GPIB/USB cable from National Instruments. Connect the cable to the GPIB connector on the back of the LIDA and tighten the connections. Plug the USB connector into the computer. If successfully installed, the computer's Device Manager will display "GPIB USB HS".

For computers which have a GPIB card, a standard GPIB cable may be used. This cable is available from Newport as model 70038, and is ordered separately.

**Figure 4: GPIB/USB Cable Connection**

## 4.7 DETECTOR CONNECTIONS

The output signal from the detector is typically connected to the Channel “A” signal input BNC connector on the front of the SR810. This connector may accept either current or voltage signals. The B output from the preamp (preamp ground) may be connected to the B input of the SR810. In this case, use A-B as the input configuration. Be sure to twist the A and B cables to avoid differential noise pickup between the cables.

Unamplified detectors provide a current signal, while amplified detectors provide a voltage signal. If the signal exceeds the maximum which can be read by the SR810, the “OVLD” indicator illuminates. The SR810 has greater dynamic reserve when reading voltage signals, so the LIDA-compatible detectors offered by Oriel are all amplified models. Additionally, Oriel offers the 70310 stand-alone current preamplifier to use with unamplified detectors or photomultiplier tubes.

Oriel’s amplified detectors and stand-alone current preamplifier require a power source to operate. The “PREAMP” connection on the back of the SR810 is able to provide the power required. It must be utilized with Oriel cable model CBL-70054-LIDA only. The user of any other Oriel cable will damage the amplifier circuit and void the warranty on the detector or stand-alone preamplifier.

This power cable, as well as a BNC signal cable, are included with all LIDA-compatible detectors offered by Oriel. For other setups, the CBL-70054-LIDA may be purchased separately. To use this power cable with the model 70310 current preamplifier, the cable’s mini-DIN connector can be cut off and the stripped wire ends may be installed into the preamplifier’s terminal block.

Note: the SR810 does NOT compensate for the gain of the preamp. The SR810 sets both preamps to their maximum gains. Measurements made by the SR810 with a preamp should be divided by the gain of the preamp.

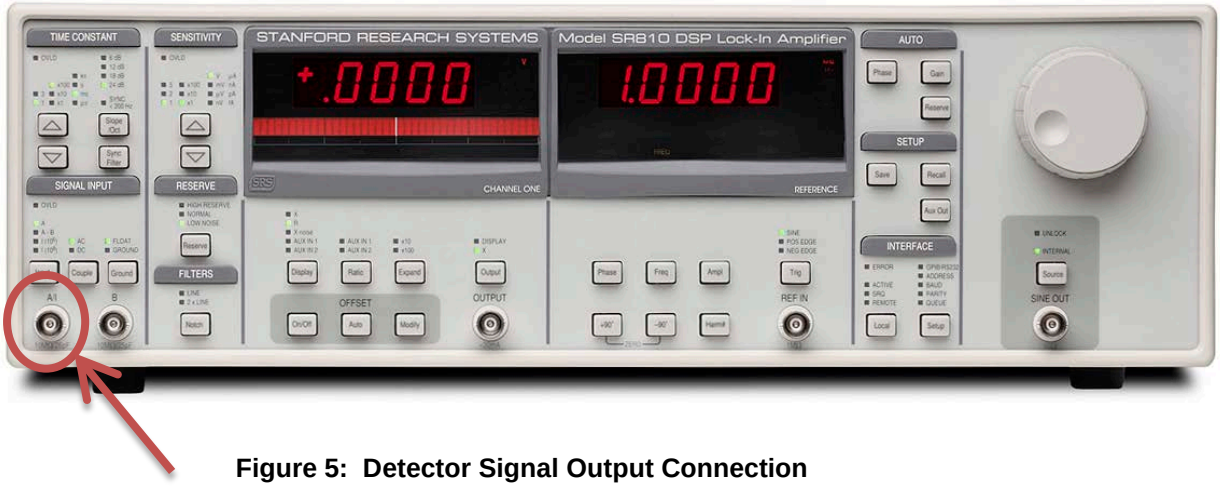



**Figure 5: Detector Signal Output Connection**

**Figure 6: Detector Amplifier Cable Model CBL-70054-LIDA**

**Figure 7: Amplifier Power Connection on SR810 with LIDA-Compatible Oriel Detector**

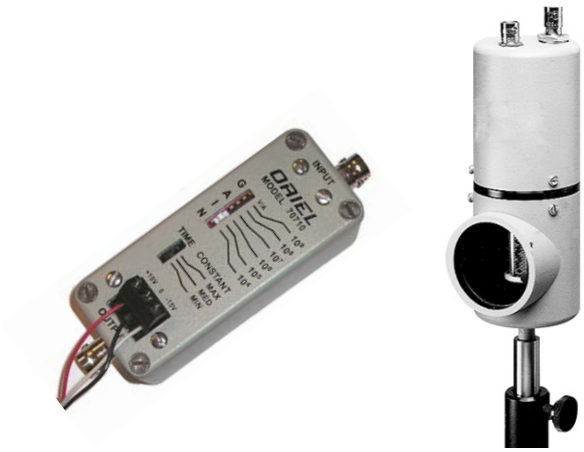



**Figure 8: Stand-Alone Preamplifier 70710 (left) with PMT Housing 70693**

## 4.8 ELECTRICAL CONNECTIONS

Before powering up the system for the first time, it is suggested to have a qualified electrician verify the wall socket to be used with the LIDA-SRS-KIT meets the requirements for operation as noted.

Before making any electrical connections, verify the power switches are in the off position for the lock-in digital amplifier and chopper controller.

| | |
|---|---|
| | **WARNING**<br><br>To avoid electric shock, connect the instrument to properly earth-grounded, 3-prong receptacles only. Failure to observe this precaution can result in severe injury or death. |

Refer to the specifications section of this users' manual for the power requirements for the lock-in digital amplifier. Refer to the specifications section of the 75160NF user's manual for the power requirements for the chopper controller.

The LIDA-SRS-KIT conforms to CE standards for both safety and EMC. During normal use, this equipment will not pose any electrical hazards to the user. Read all warnings before installing or operating this system. If there are any questions or concerns, contact Oriel Instruments or the regional sales representative for Newport.

| | |
|---|---|
| | **ELECTRICAL SHOCK**<br><br>Never attempt to open the lock-in digital amplifier. This items does not contain any user serviceable parts. Failure to follow this warning can result in severe injury or death. |

**Figure 9: Main Power Connector and On/Off Switch Locations**

# 5 SOFTWARE CONFIGURATION

Follow the instructions provided with TracQ Basic to install the software onto a computer. The software is used to control the LIDA settings. After the setup is complete, TracQ Basic allows the user to select the desired chopping frequency and operating parameters for the SR810.

The software is also able to control various Oriel monochromators. Please refer to the user's manual included with the software for a list of compatible instruments.

## 5.1 ESTABLISHING COMMUNICATION

The SR810 must be connected to the computer with the GPIB/USB cable and powered on before opening the software application. When starting the TracQ Basic software for the first time, prompts guide the user to select the detection instrument and monochromator for the system. If no monochromator instrument is to be used, click Cancel. Otherwise, select the instrument based on the instructions provided with the software.

To select the LIDA, navigate to the following folder:
C:\Program Files\Newport – Oriel Instruments\TracQ Basic.

Highlight the folder named "SR810", then click Select Folder.

Verify that the indicator on the front panel of the software is green for the Detection Instrument and monochromator, if utilized. If the SR810 communication cannot be established, go to Detector Instr. → Setup Communication and verify the appropriate GPIB address is selected.

The GPIB address should match the setting on the SR810. To view the GPIB address on the SR810, press the Setup button under INTERFACE on the front panel of the instrument until the Address LED is illuminated. The right side reference display will show the GPIB address. To change the address, rotate the SR810 front panel knob.

**Figure 10: SR810 GPIB Address Selection**

**Figure 11: View GPIB Address on SR810**

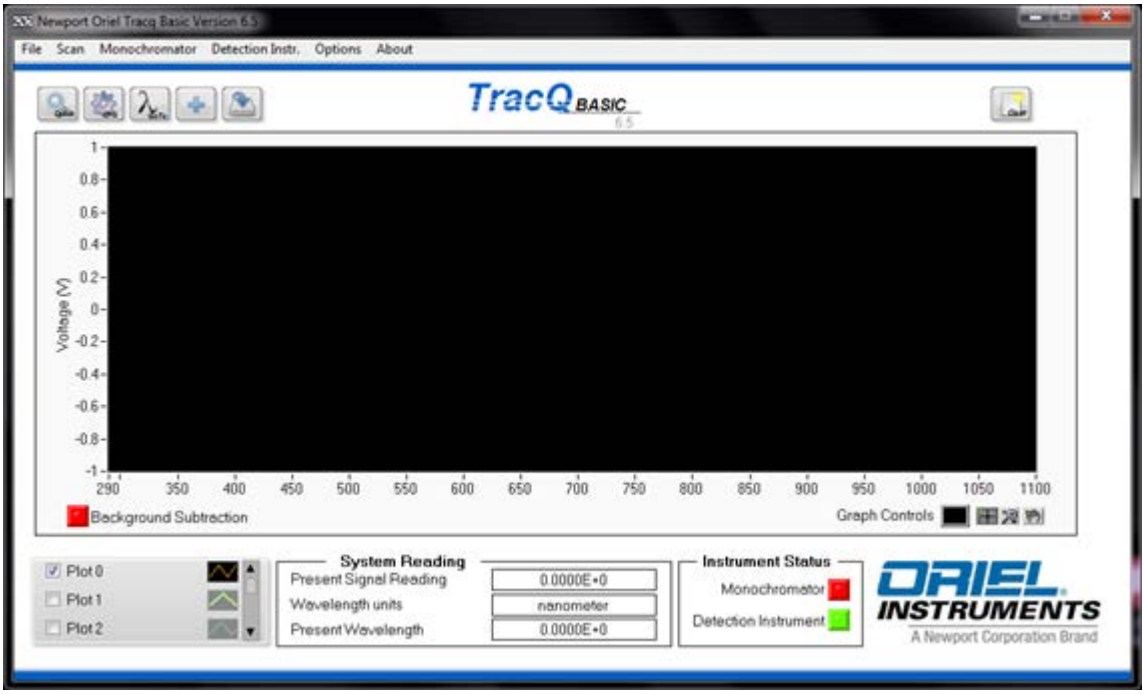



**Figure 12: LIDA Communication Established**

## 5.2 SETTING OPERATING PARAMETERS

To set the chopping frequency and other operating parameters for the SR810, select Detection Instr. → Setup Parameters.

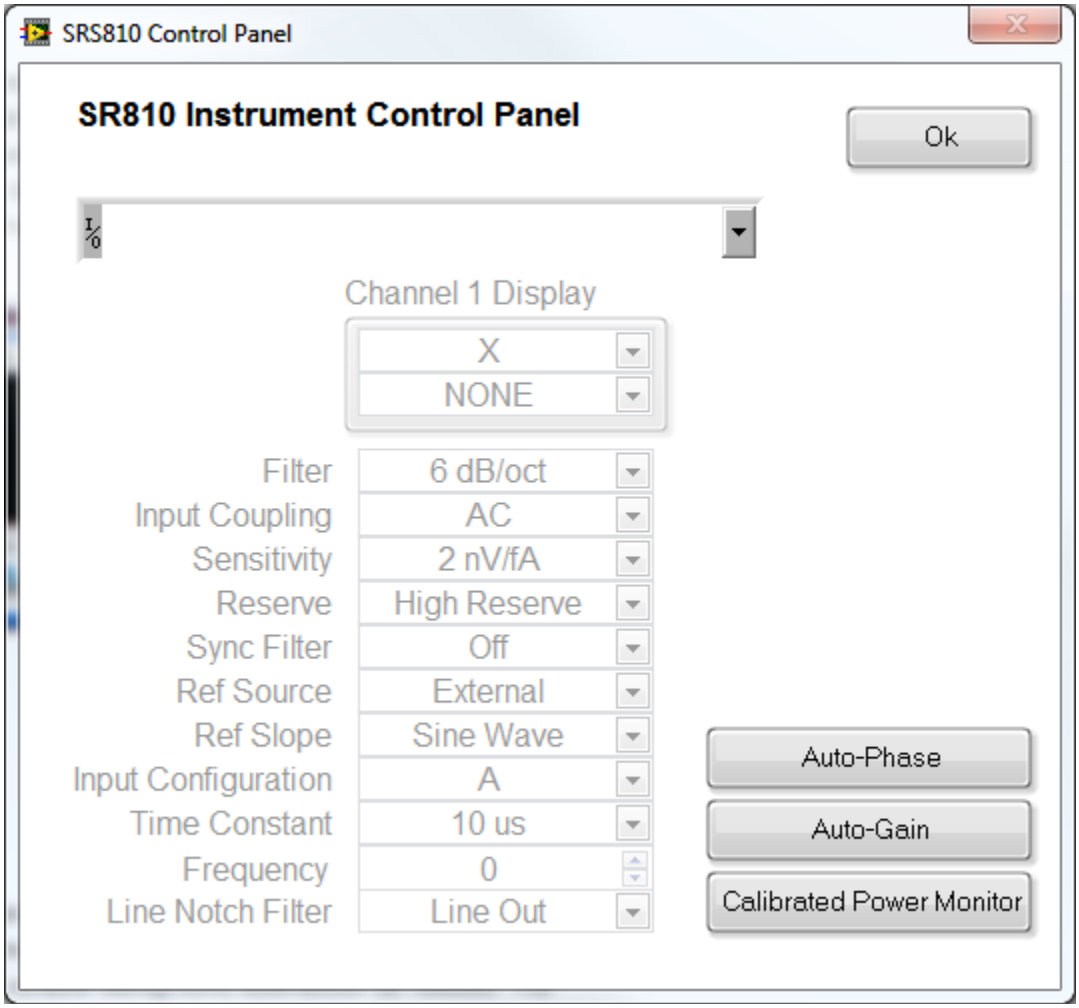



**Figure 13: Setting Operating Parameters in TracQ Basic**

# 6 BASIC OPERATION

## 6.1 SET INTERNAL FREQUENCY GENERATOR

Set the SR810 to lock using the internal frequency generator by pressing the SOURCE button on the front panel of the instrument until the INTERNAL LED is active.

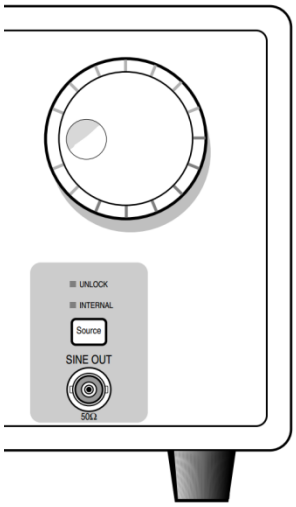



**Figure 14: Source Button, SINE out and Frequency Selector Knob**

## 6.2 SET SIGNAL INPUT MODE

Set the SR810 for current mode operation by pressing the INPUT button on the front panel of the instrument until the I($10^6$) or I($10^8$) LED indicator is active. This is used with unamplified detectors. Select A or A-B when using amplified detectors with a voltage signal.

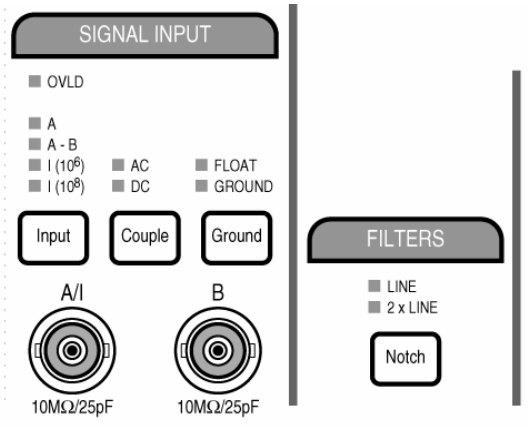



**Figure 15: Signal Input Connections**

## 6.3 SET AUTO GAIN AND AUTO PHASE

Slowly expose the covered detector and chopper head to room lighting taking care not to overload the SR810. You will see an overload indicator (OVLD) next to the digital LED display. Press the AUTOGAIN and AUTOPHASE buttons on the front panel of the SR810. The output LED display indicator will show the RMS current detected by the unamplified detector. If the OVLD indicator is on after AUTOGAIN was used, the signal input is too large, and you must decrease the optical signal on the detector. Please refer to the SR810 User's Manual for warnings and further details.

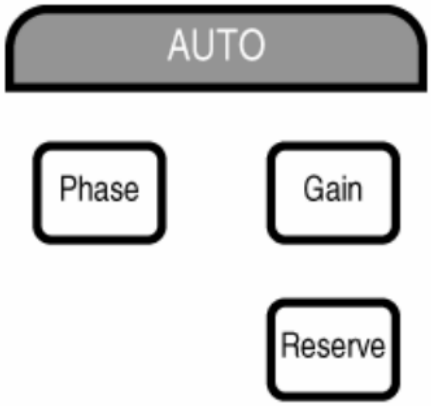



**Figure 16: Auto Gain and Phase Buttons**

# 7 ADVANCED CONFIGURATIONS AND APPLICATIONS

The SR810 is a powerful instrument with many features. They are described in detail in the user's manual provided with the instrument. Some of the many possible configurations are discussed here. For more details, refer to the SR810 user's manual.

## 7.1 RATIO MODE SETUP

A reference input corrects the measurement channel to compensate for source drift. The LIDA-SRS-KIT system allows you to take readings in a ratio mode by providing a reference channel input. This serves to improve the accuracy of response measurements by removing the source variability.

Any detector type can be utilized for reference if its signal level is compatible with the limited dynamic range of the reference channel. The range is -10.5 V to +10.5 V and the resolution is 16 bits (1/3 mV). The input impedance is 1 MΩ. The AUX 1 and 2 inputs on the rear panel of the SRS SR810 may be displayed on the CH1 display. These inputs allow signals other than the lock-in outputs to be acquired and stored. Furthermore, ratio quantities, such as X/Aux1, may be displayed. TracQ Basic can display the ratio quantities. This data is displayed on the SR810 Instrument Control Panel

Items needed to build the setup shown in Figure 19:

- LIDA-SRS-KIT
- Monochromator (example: Oriel model CS260-USB-1-FH-A)
- Amplified, calibrated detector (example: Oriel model DET-L-SIUV-R-C)
- Amplified, uncalibrated detector (example: Oriel model 71883)
- Tunable Light Source, 300W Xenon (Oriel model TLS-300X)
- Beamsplitter (example: Newport model 20B20NC.1)

**Figure 17: Reference Connections**

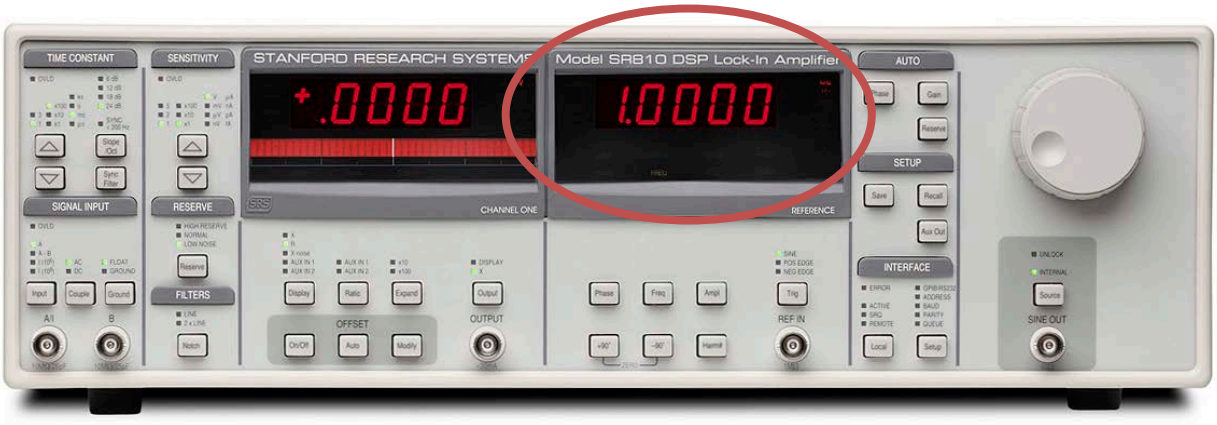



**Figure 18: Reference Display**

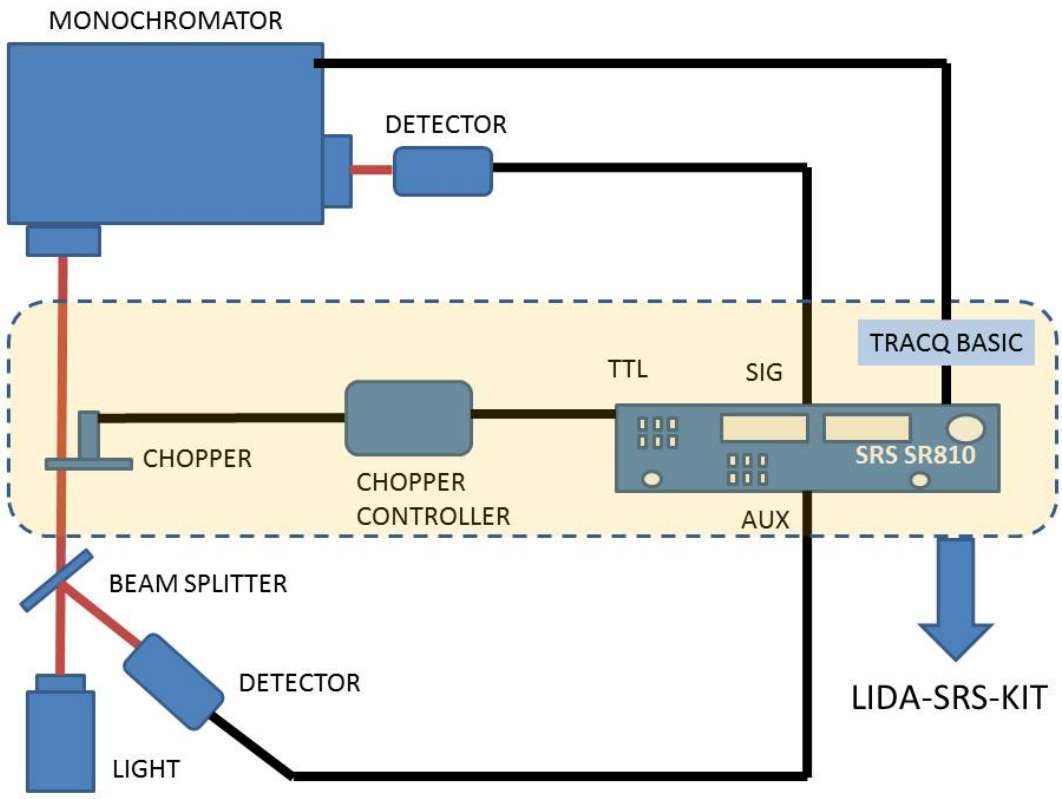



**Figure 19: Ratio Measurement Configuration**

## 7.2 CALIBRATION

The LIDA-SRS-KIT with TracQ Basic can display simple voltage or current measurements as well as calibrated readings in radiometric units. Most of Oriel's LIDA-compatible detectors are available with spectral responsivity data. This type of detector can calculate incident power and it display the readings in real time. Figure 20 shows the measurement setup of light output from the Monochromator.

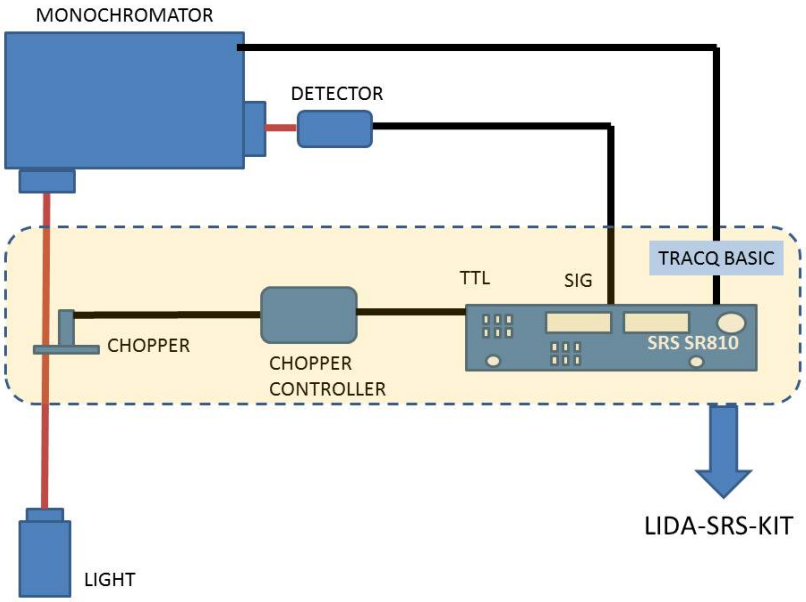



**Figure 20: Oriel Monochromator Integration with TracQ Basic**

Items needed to build the setup shown in Figure 20:

- LIDA-SRS-KIT
- Monochromator (example: Oriel model CS260-USB-Q-FH-A)
- Amplified, calibrated detector (example: Oriel model DET-L-SIUV-R-C)
- Tunable Light Source, 300W Xenon (Oriel model TLS-300X)

Because the LIDA-SRS-KIT is compatible with a wide variety of detectors, the precise procedure for obtaining calibrated results varies. It is typically necessary to load wavelength and responsivity values into one of the wavelength tables, to enter a calibration scale number, and to enter the wavelength at which the measurement will be taken. With these three steps, the LIDA-SRS-KIT will display accurate calibrated data in watts.

The Oriel detector model DET-L-SIUV-R-C is calibrated from 200 to 1000 nm at room temperature and has a 10 x 10 mm square active area. The built-in transimpedance amplifiers allow the gain to be set from $10^4$ V/A to $10^9$ V/A.

The calibrated data file provided with the detector has two columns of tabulated data, wavelength and responsivity, as shown in Figure 21. After the calibrated data is loaded into TracQ Basic, the detector gain value needs to be entered. The detector gain value must match the gain switch position on the detector. Figure 22 illustrates the software's gain setting dialog box.

Prior to taking a detector radiometry data, the wavelength range an wavelength step size (interval) need to be set. Once this information is entered into the software, the detector radiometry scan allows radiant measurement data to be taken over the detector's calibrated wavelength range. For further detailed instructions of calibrated operations, please refer to the TracQ Basic user's manual.

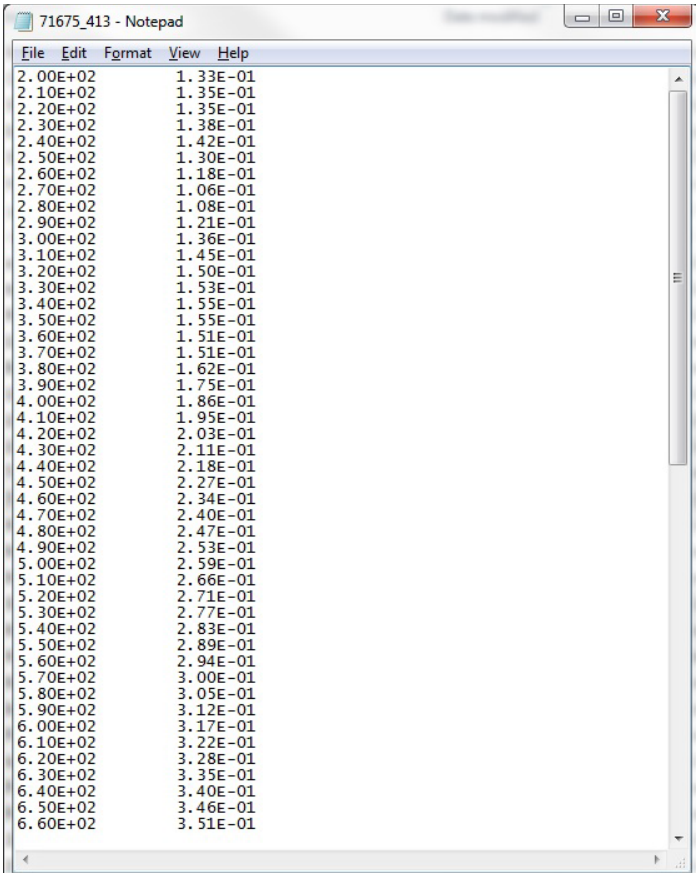



**Figure 21: Calibrated Detector File**

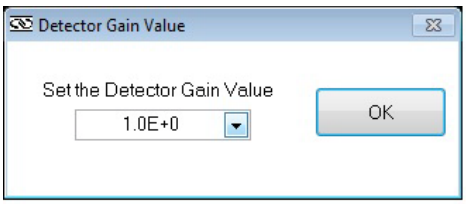



**Figure 22: Setting Detector Gain Value**

## 7.3 QUANTUM EFFICIENCY MEASUREMENTS

The LIDA-SRS-KIT allows researchers to measure Quantum Efficiency (QE), also known as Incident Photon to Charge Carrier Efficiency (IPCE), for solar cells, detectors, or any other photon-to-charge converting device.

TracQ Basic software allows the LIDA-SRS-KIT and Oriel Monochromators to coordinate their operation in order to obtain QE data. TracQ Basic features built-in QE measurement functionality which allows signal data from the LIDA-SRS-KIT to be displayed in real time.

Items needed to build the setup shown in Figure 23:

- LIDA-SRS-KIT
- Monochromator (example: Oriel model CS260-USB-Q-FH-A)
- Amplified, calibrated detector (example: Oriel model DET-L-SIUV-R-C)
- Sample solar cell or uncalibrated detector
- Tunable Light Source, 300W Xenon (Oriel model TLS-300X)

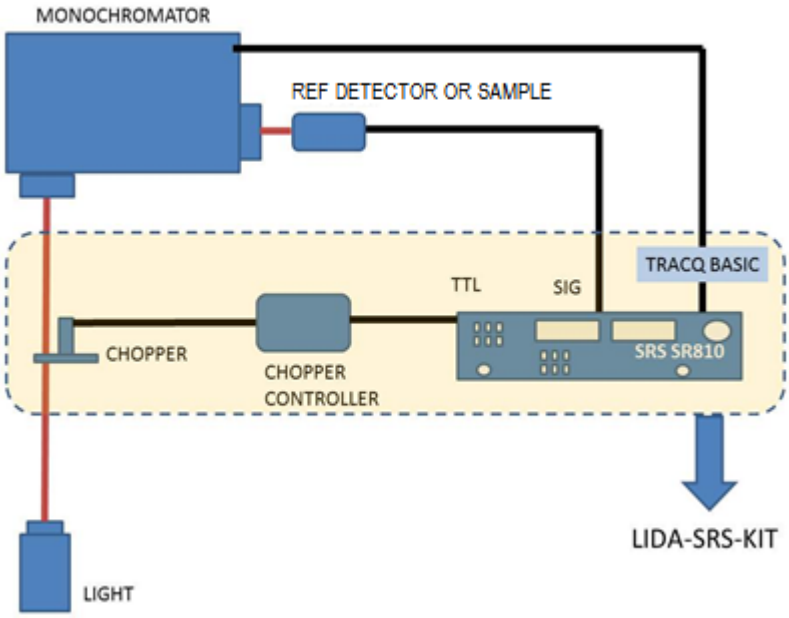



**Figure 23: QE Measurement Configuration**

The user selects the grating and filter changeover wavelengths for the monochromator and motorized filter wheel. The SR810 parameters are set up, as well as the scan parameters. A reference scan of a detector or sample with known spectral responsivity is taken. This is followed by a scan of the device for which QE needs to be determined. This data is plotted and can be saved to a file. The TracQ Basic user's manual provides further information on performing QE scans.

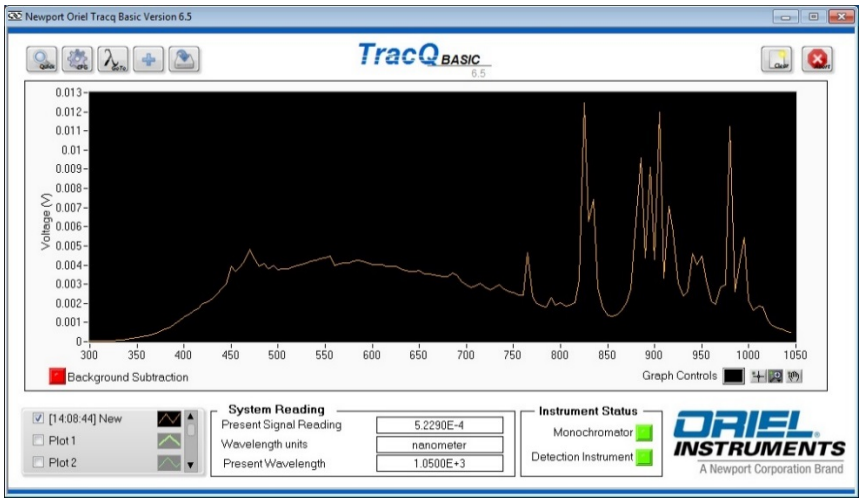



**Figure 24: Reference Spectra Measurement Using TracQ Basic**

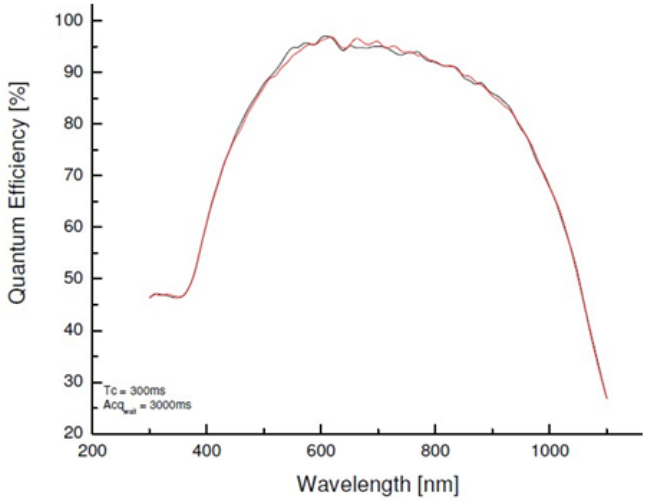



**Figure 25: QE Measurements of Samples**

# 8 DETECTORS

## 8.1 ORIEL LIDA-COMPATIBLE DETECTORS

A broad selection of detectors are compatible with this system, allowing measurement of optical radiation from UV to IR. Each LIDA detector includes an integrated amplifier. All models except pyroelectric include a selectable gain switch. The LIDA detectors include all cables necessary to perform measurements.

Thermoelectrically cooled detectors include a cable that connects to the 77055 Cooler Controller. A special cable is included with each LIDA detector, providing power from the SR810 to the integrated detector amplifiers.

Each detector model features a 1.5-inch series flange, which is compatible with a wide variety of Oriel accessories and instruments. A 1/4-20 threaded hole is located on the bottom of the housing, allowing the any detector to be rod mounted if desired.

| Model Number | Description |
|---|---|
| DET-L-SIUV-R-C | UV-enhanced Si photodiode w/transimpedance amplifier, 200-1100 nm sensitivity, 10 mm x 10 mm active area, NIST traceable calibration |
| DET-L-SIUV-T-C | UV-enhanced Si photodiode w/integrated transimpedance amplifier, 200-1100 nm sensitivity, 1-stage TE cooled, 5 mm diameter active area, NIST traceable calibration |
| DET-L-GE-R-C | Ge photodiode w/integrated transimpedance amplifier, 700-1800 nm sensitivity, 5 mm diameter active area, NIST traceable calibration |
| DET-L-GE-T-C | Ge photodiode w/integrated transimpedance amplifier, 700-1800 nm sensitivity, 2-stage TE cooled, 5 mm diameter active area, NIST traceable calibration |
| DET-L-PYC5-R-P | Lithium tantalate pyroelectric detector w/integrated FET amplifier and high speed signal processing electronics, 0.45-9 µm sensitivity, 5 mm diameter active area, NIST traceable calibration |
| DET-L-PYK5-R-P | Lithium tantalate pyroelectric detector w/integrated FET amplifier and signal processing electronics, 0.6-50 µm sensitivity, 5 mm diameter active area, NIST traceable calibration |
| DET-L-PBS-R-U | PbS photodiode w/integrated voltage supply and AC coupled pre-amplifier, 0.7-0.3 um sensitivity, 3 mm x 3 mm active area |

## 8.2 OTHER DETECTORS

The LIDA system also supports other detectors, both amplified and unamplified, with a BNC output connector. The 70710 Preamplifier, when used with an unamplified detector, converts the signal from current to voltage. This option allows users to take advantage of the LIDA system's greater dynamic range for voltage readings.

Many of Oriel's legacy amplified detectors may easily be integrated with the LIDA, provided the detector has Mini-DIN and BNC connectors. Discard the Mini-DIN connector included with the legacy detector and replace it with cable model CBL-70054-LIDA to provide power to the built-in preamplifier. Add a BNC cable, such as the model 70018, to send the signal output from the detector to the LIDA.

Oriel's HgCdZnTe detectors, typically used with the MIR8035 FTIR, may be easily integrated with the LIDA-SRS-KIT. Simply discard the FTIR cable and replace with a BNC cable, then connect to the SR810.

**Figure 26: Oriel HgCdZnTe Detector**

# 9 SPECIFICATIONS

| SIGNAL CHANNEL | |
|---|---|
| Number of Detector Channels | 1 |
| Voltage Inputs | Single-ended or differential |
| Sensitivity | 2 nV to 1 V |
| Current Input | $10^6$ or $10^8$ V/A |
| Voltage Input Impedance | 10 MΩ + 25 pF, AC or DC coupled |
| Current Input Impedance | 1 kΩ to virtual ground |
| Gain accuracy | ±1% (±0.2% typ.) |
| Noise | 6 nV/√Hz at 1 kHz |
| | 0.13 pA/√Hz at 1 kHz ($10^6$ V/A) |
| | 0.013 pA/√Hz at 100 kHz (108 V/A) |
| Line Filters | 50/60 Hz and 100/120 Hz (Q=4) |
| Common Mode Rejection Ratio | 100 dB at 10 kHz, decreasing by 6 dB/oct above 10 kHz |
| Dynamic Reserve | >100 dB (without prefilters) |
| Stability | <5 ppm/°C |
| **REFERENCE CHANNEL** | |
| Frequency Range | 0.001 Hz to 102.4 kHz |
| | hopper wheel dependent |
| Reference Input | TTL or sine (400 mVpp min.) |
| Input Impedance | 1 MΩ, 25 pF |
| Phase Resolution | 0.01° front panel, 0.008° through computer interfaces |
| Absolute Phase Error | <1° |
| Relative Phase Error | <0.001° |
| Orthogonality | 90° ± 0.001° |
| Int. Reference Phase Noise | Synthesized, <0.0001° rms at 1 kHz |
| Ext. Reference Phase Noise | 0.005° rms at 1 kHz, 100 ms, 12 dB/oct |
| Phase Drift | <0.01°/°C below 10 kHz |
| | <0.1°/°C, 10 kHz to 100 kHz |
| Harmonic Detection | 2F, 3F, ... nF to 102 kHz (n < 19,999) |
| Acquisition Time | (2 cycles + 5 ms) or 40 ms, whichever is greater |
| **DEMODULATOR** | |
| Stability | Digital outputs and display: no drift. |
| | Analog outputs: <5 ppm/°C for all dynamic reserve settings. |
| Harmonic Rejection | -90 dB |
| Time Constants | 10 µs to 30 ks (6, 12, 18, 24, dB/oct roll off). Synchronous filters available below 200 Hz. |
| **INTERNAL OSCILLATOR** | |

| | |
|---|---|
| Range | 1 MHz to 102 kHz |
| Accuracy | 25 ppm + 30 µHz |
| Frequency Resolution | 4-1/2 digits or 0.1 MHz, whichever is greater |
| Distortion | -80 dBc (f<10 kHz), -70 dBc (f> 10 kHz) @ 1 Vrms amplitude |
| Amplitude | 0.004 to 5 Vrms into 10 kΩ (2 mV resolution), 50 Ω output impedance, 50 mA maximum current into 50 Ω |
| Amplitude Accuracy | 1% |
| Amplitude Stability | 50 ppm/°C |
| Outputs | Sine, TTL |
| | When using an external reference, both outputs are phase locked to the external reference. |
| **DISPLAYS** | |
| Channel 1 Output | ±10 V output of X, R, X-noise, Aux 1 or Aux 2. Updated at 512 Hz. |
| Offset | X, Y, R can be offset up to ±105% of full scale |
| Expand | X, Y, R can be expanded by 10x or 100x |
| Reference | 4-1/2 digit LED display |
| **INPUTS AND OUTPUTS** | |
| Channel 1 Output | ±10 V output of X, R, X-noise, Aux 1 or Aux 2. Updated at 512 Hz. |
| X, Y Outputs | In-phase and quadrature components |
| (rear panel) | (±10 V), updated at 256 kHz |
| Aux. A/D Inputs | 4 BNC inputs, ±10 V, 1 mV resolution, sampled at 512 Hz |
| Aux. D/A Outputs | 4 BNC outputs, ±10 V, 1 mV resolution |
| Sine Out | Internal oscillator analog output |
| TTL Out | Internal oscillator TTL output |
| Data Buffer | 8k point buffer with data recorded at rates to 512 Hz and read through the computer interfaces. |
| Trigger In (TTL) | Trigger synchronizes data recording |
| Remote Pre-amp | Provides power to the preamplifier integrated inside Oriel's LIDA detectors, using cable Model CBL-70054-LIDA |
| Computer Interface | IEEE-488.2 and RS-232 interfaces standard. All instrument functions can be controlled and read through IEEE-488.2 or RS-232 interfaces. TracQ Basic software utilizes GPIB communication. |
| **GENERAL** | |
| Power | 100 to 120 VAC, 220 to 240 VAC, 50 to 60 Hz, 40 W |
| Dimensions | 17" W x 5.25" H x 19.5" L [431 x 133 x 495 mm] |
| Weight | 30 lbs [13.6 kg] |

# 10 WARRANTY AND SERVICE

## 10.1 CONTACTING NEWPORT CORPORATION

Oriel Instruments belongs to Newport Corporation's family of brands. Thanks to a steadfast commitment to quality, innovation, hard work and customer care, Newport is trusted the world over as the complete source for all photonics and laser technology and equipment.

Founded in 1969, Newport is a pioneering single-source solutions provider of laser and photonics components to the leaders in scientific research, life and health sciences, photovoltaics, microelectronics, industrial manufacturing and homeland security markets.

Newport Corporation proudly serves customers across Canada, Europe, Asia and the United States through numerous international subsidiaries and sales offices worldwide. Every year, the Newport Resource catalog is hailed as the premier sourcebook for those in need of advanced technology products and services. It is available by mail request or through Newport's website. The website is where one will find product updates, interactive demonstrations, specification charts and more.

To obtain information regarding sales, technical support or factory service, United States and Canadian customers should contact Newport Corporation directly.

Newport - Oriel Instruments
1791 Deere Avenue
Irvine, CA 92606 USA

Telephone: 800-222-6440 (toll-free in United States)
949-863-3144

Fax: 949-253-1680

Sales: oriel.sales@newport.com
Technical assistance: oriel.tech@newport.com
Repair Service: rma.service@newport.com

Customers outside of the United States must contact their regional representative for all sales, technical support and service inquiries. A list of worldwide representatives can be found on the following website: http://www.newport.com/oriel.

## 10.2 REQUEST FOR ASSISTANCE / SERVICE

Please have the following information available when requesting assistance or service:

Contact information for the owner of the product.
Instrument model number (located on the product label).
Product serial number and date of manufacture (located on the product label).
Description of the problem.

To help Newport's Technical Support Representatives diagnose the problem, please note the following:

Is the system used for manufacturing or research and development?
What was the state of the system right before the problem?
Had this problem occurred before? If so, when and how frequently?
Can the system continue to operate with this problem, or is it non-operational?
Were there any differences in the application or environment before the problem occurred?

## 10.3 REPAIR SERVICE

This section contains information regarding factory service for this product. The user should not attempt any maintenance or service of the system beyond the procedures outlined in this manual. This product contains no user serviceable parts other than what is noted in this manual. Any problem that cannot be resolved should be referred to Newport Corporation.

If the instrument needs to be returned for service, a Return Material Authorization (RMA) number must be obtained prior to shipment to Newport. This RMA number must appear on both the shipping container and the package documents.

Return the product to Newport, freight prepaid, clearly marked with the RMA number and it either will be repaired or replaced it at Newport's discretion.

Newport is not responsible for damage occurring in transit. The Owner of the product bears all risk of loss or damage to the returned Products until delivery at Newport's facility. Newport is not responsible for product damage once it has left the facility after repair or replacement has been completed.

Newport is not obligated to accept products returned without an RMA number. Any return shipment received by Newport without an RMA number may be reshipped by Newport, freight collect, to the Owner of the product.

## 10.4 NON-WARRANTY REPAIR

For Products returned for repair that are not covered under warranty, Newport's standard repair charges shall be applicable in addition to all shipping expenses. Unless otherwise stated in Newport's repair quote, any such out-of-warranty repairs are warranted for ninety (90) days from date of shipment of the repaired Product.

Newport will charge an evaluation fee to examine the product and determine the most appropriate course of action. Payment information must be obtained prior to having an RMA number assigned. Customers may use a valid credit card, and those who have an existing account with Newport Corporation may use a purchase order.

When the evaluation had been completed, the owner of the product will be contacted and notified of the final cost to repair or replace the item. If the decision is made to not proceed with the

repair, only the evaluation fee will be billed. If authorization to perform the repair or provide a replacement is obtained, the evaluation fee will be applied to the final cost. A revised purchase order must be submitted for the final cost. If paying by credit card, written authorization must be provided that will allow the full repair cost to be charged to the card.

## 10.5 WARRANTY REPAIR

If there are any defects in material or workmanship or a failure to meet specifications, notify Newport Corporation promptly, prior to the expiration of the warranty.

Except as otherwise expressly stated in Newport's quote or in the current operating manual or other written guarantee for any of the Products, Newport warrants that, for the period of time set forth below with respect to each Product or component type (the "Warranty Period"), the Products sold hereunder will be free from defects in material and workmanship, and will conform to the applicable specifications, under normal use and service when correctly installed and maintained. Newport shall repair or replace, at Newport's sole option, any defective or nonconforming Product or part thereof which is returned at Buyer's expense to Newport's facility, provided, that Buyer notifies Newport in writing promptly after discovery of the defect or nonconformity and within the Warranty Period. Products may only be returned by Buyer when accompanied by a return material authorization number ("RMA number") issued by Newport, with freight prepaid by Buyer. Newport shall not be responsible for any damage occurring in transit or obligated to accept Products returned for warranty repair without an RMA number. The buyer bears all risk of loss or damage to the Products until delivery at Newport's facility. Newport shall pay for shipment back to Buyer for Products repaired under warranty.

WARRANTY PERIOD

All Products (except consumables such as lamps, filters, etc.) described here are warranted for a period of twelve (12) months from the date of shipment or 3000 hours of operation, whichever comes first.

Lamps, gratings, optical filters and other consumables / spare parts (whether sold as separate Products or constituting components of other Products) are warranted for a period of ninety (90) days from the date of shipment.

WARRANTY EXCLUSIONS

The above warranty does not apply to Products which are (a) repaired, modified or altered by any party other than Newport; (b) used in conjunction with equipment not provided or authorized by Newport; (c) subjected to unusual physical, thermal, or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling, alteration, or tampering, or (d) considered a consumable item or an item requiring repair or replacement due to normal wear and tear.

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Persons receiving goods for demonstrations or temporary use or in any manner in which title is not transferred from Newport shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their original condition upon delivery, and for assuming all costs and charges.

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